

Michigan Wellhead Protection Program



Seven Elements of WHPP

- 1) Roles and Responsibilities: identify WHPP team
- 2) Wellhead Protection Area (WHPA): delineate the area that contributes groundwater to wells
- 3) Sources of Contamination: inventory sources of contamination within the WHPA
- 4) Management: develop methods/plan to manage the WHPA and minimize threat to water supply (e.g. land-use restrictions, BMPs)
- 5) Contingency Planning: personnel, equipment and procedures to respond to water supply emergencies
- 6) New Wells: incorporate new sources into WHPP
- 7) Public Outreach and Education: involve the community - administrators, customers, etc.

WELLHEAD PROTECTION A HISTORICAL PERSPECTIVE

JAMESTOWN VIRGINIA'S SOURCE WATER PROTECTION PROGRAM

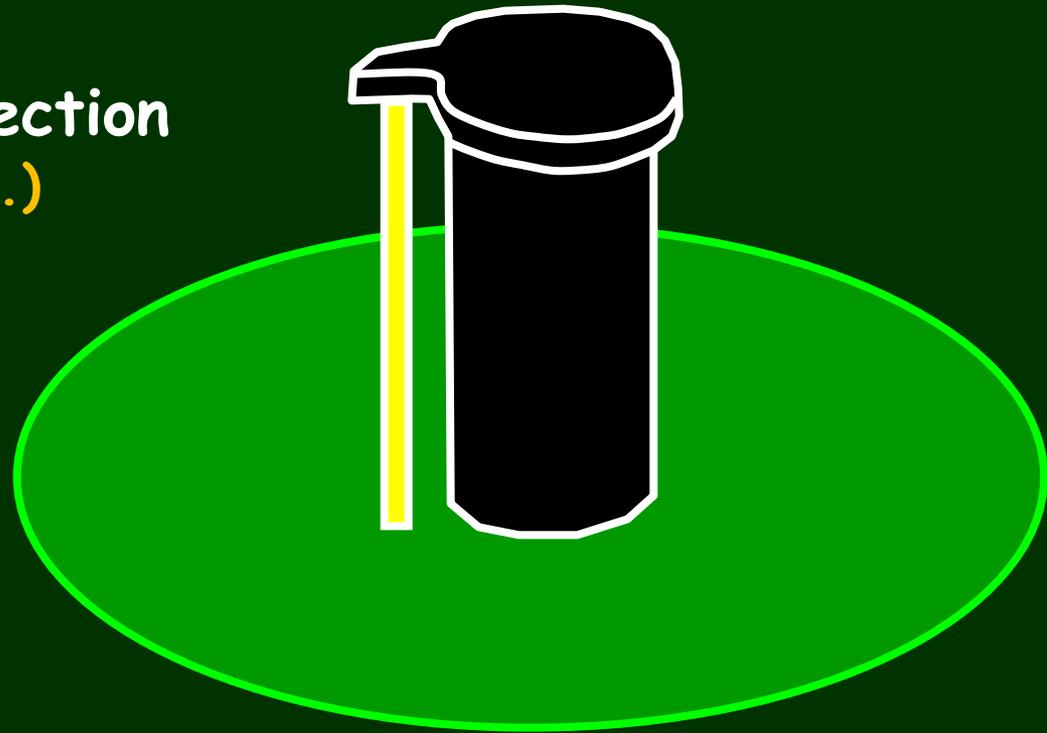
THE PROCLAMATION - 1610

"There shall be no man or woman dare to wash any unclean linen, wash clothes...nor rinse or make clean any kettle, pot or pan, or any suchlike vessel within twenty feet of the old well or new pump. Nor shall anyone aforesaid within less than a quarter mile of the fort, dare to do the necessities of nature, since by these unmanly, slothful, and loathsome immodesties, the whole fort may be choked and poisoned."

Governor Gage

Traditional Approach to Protecting GW Supplies

- Maintain Isolation Distance from “minor” and “major” sources
- Minor or Sanitary Protection Radius (*septic system, etc.*)
 - Community – 200 feet
 - Noncommunity - 75 feet
- Major - existing and “big potential” contaminant sources
 - Community – 2000 feet
 - Noncommunity - 800 feet(LUST, landfills, environmental contamination (201 Sites), bulk chemical storage)



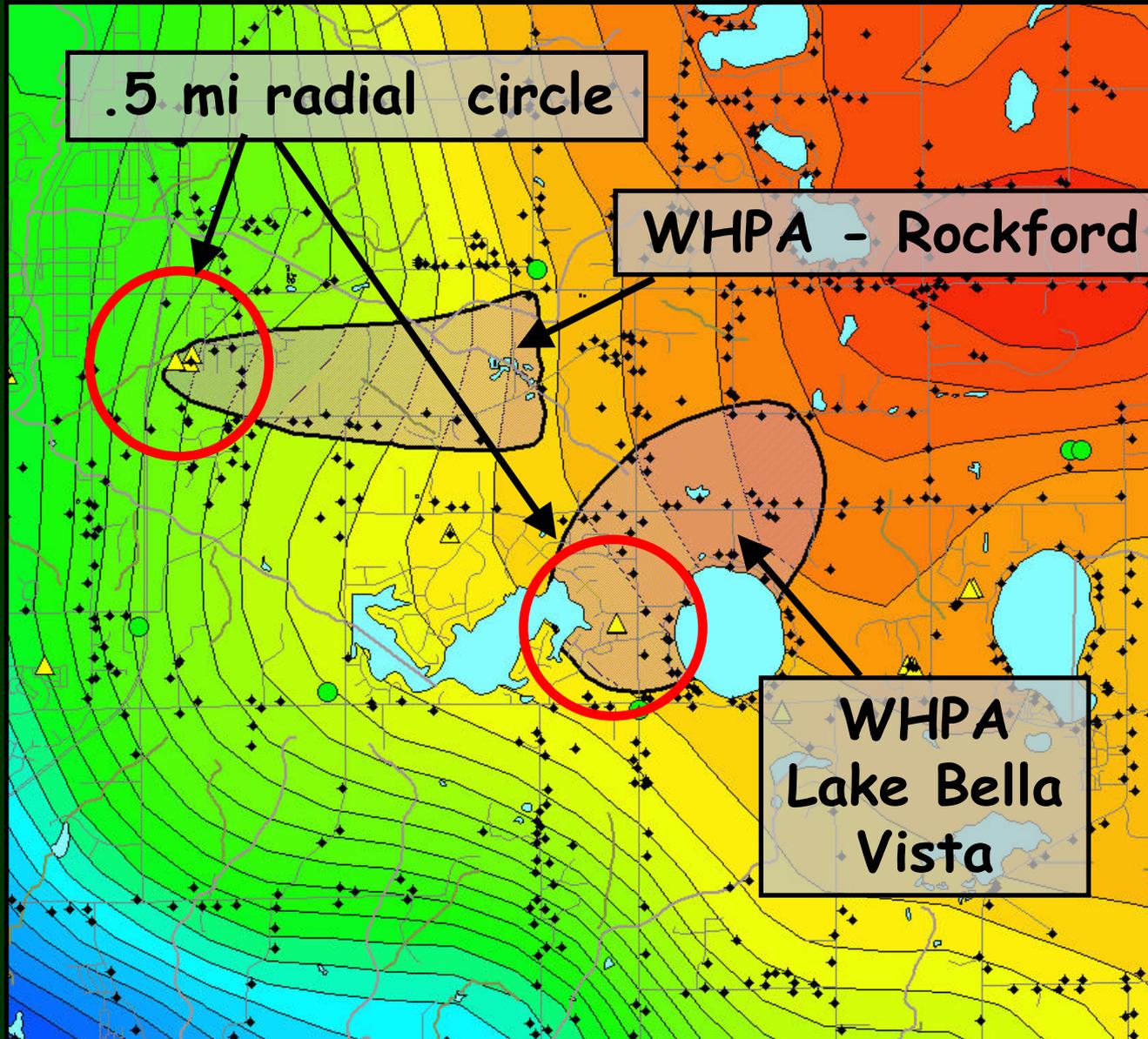
Wellhead Protection Area (WHPA)

The surface and subsurface area surrounding a water well or well field, supplying a public water system, through which contaminants are reasonably likely to move toward and reach such water well or wellfield

WHPA = 10 year time-of-travel

Synonyms: contributing area, capture zone, zone of capture

GW Flow-Based Delineation vs Fixed Radius



What information is needed to delineate WHPA?

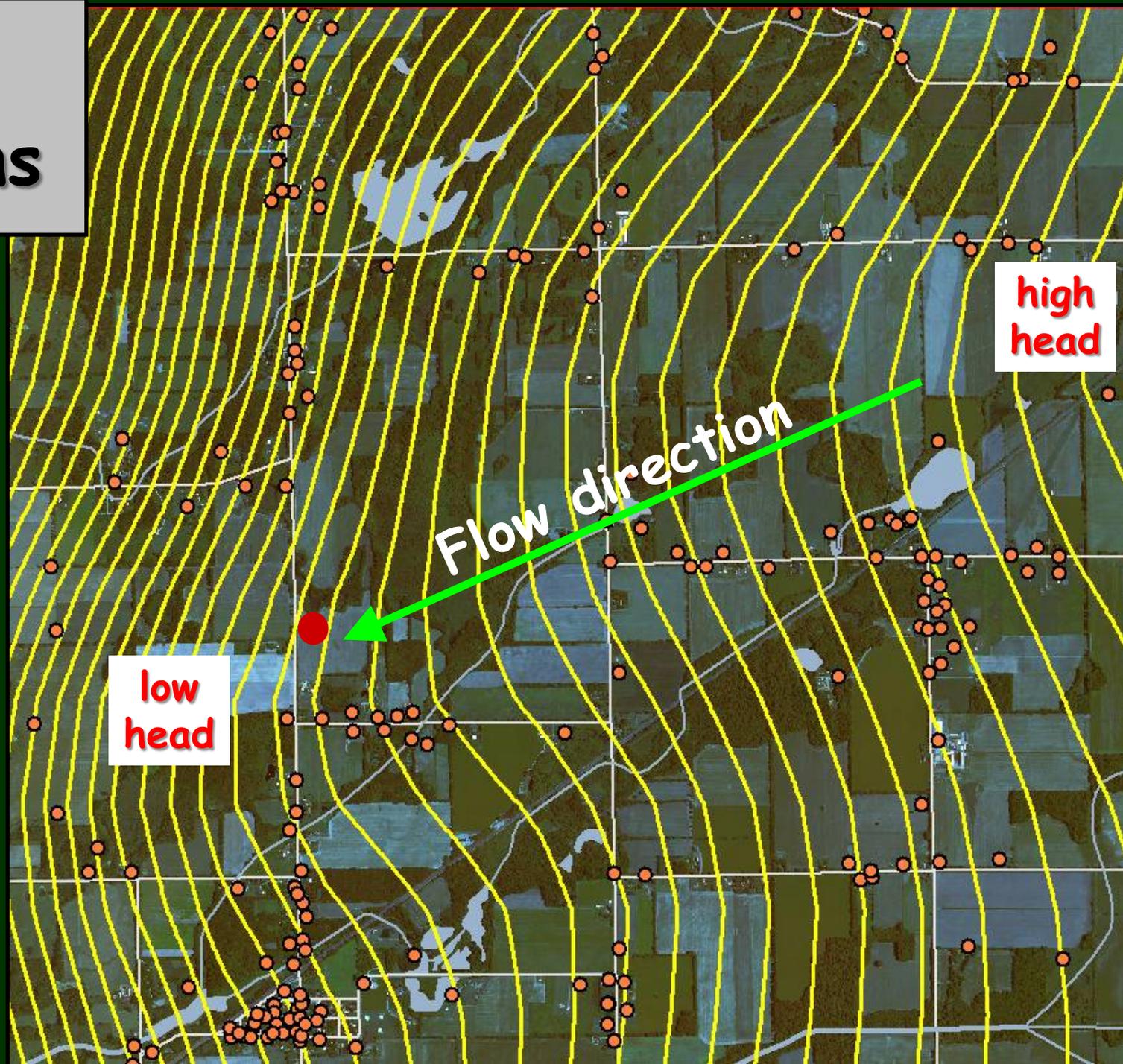
- Well Location
- GW Elevations
- Hydraulic Conductivity
- Pumping Rate

**Most
Important**



Map GW Elevations

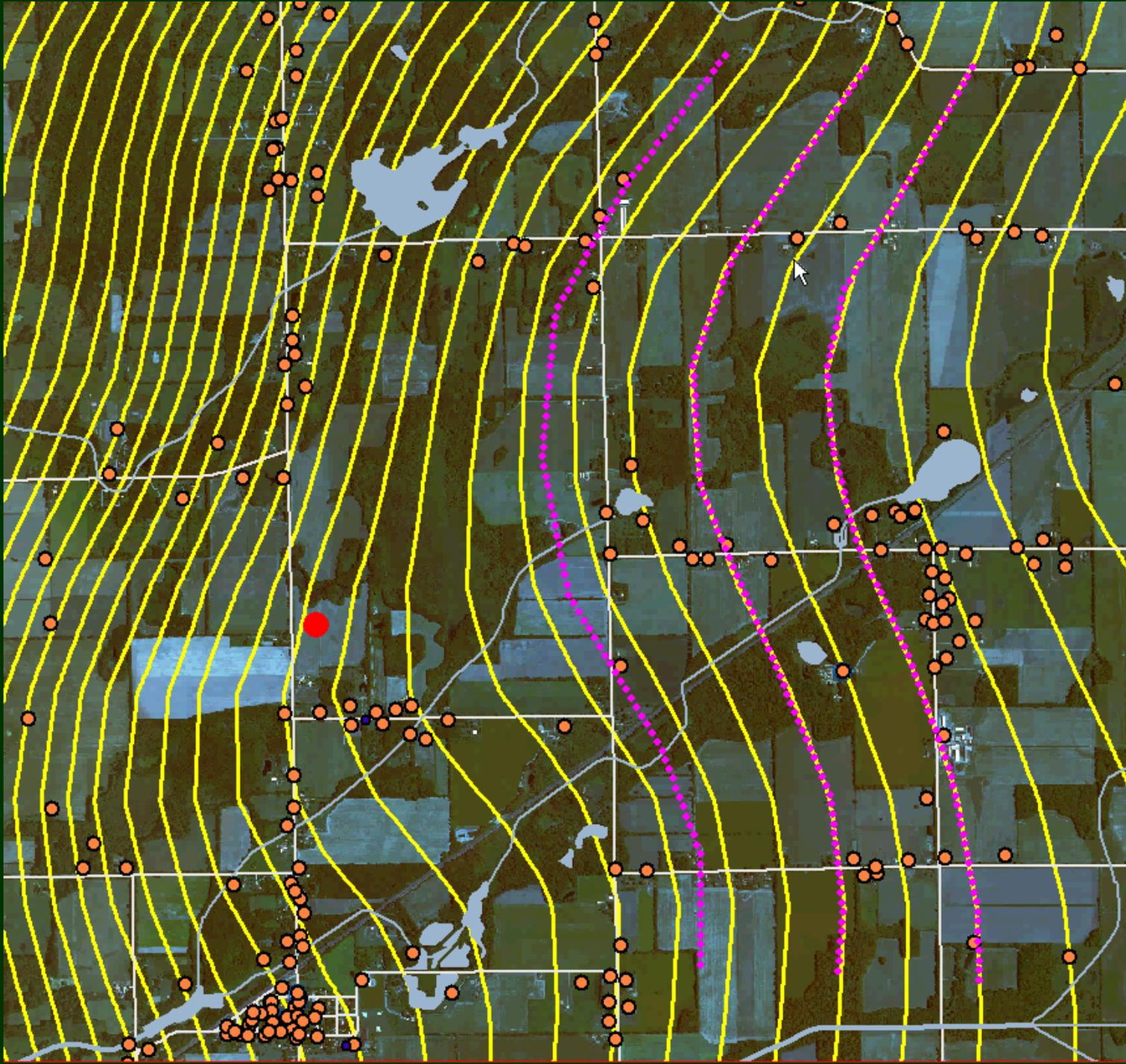
Yellow lines depict lines of equal potential or equivalent head



**GW
Flow**

**No
Pumping**

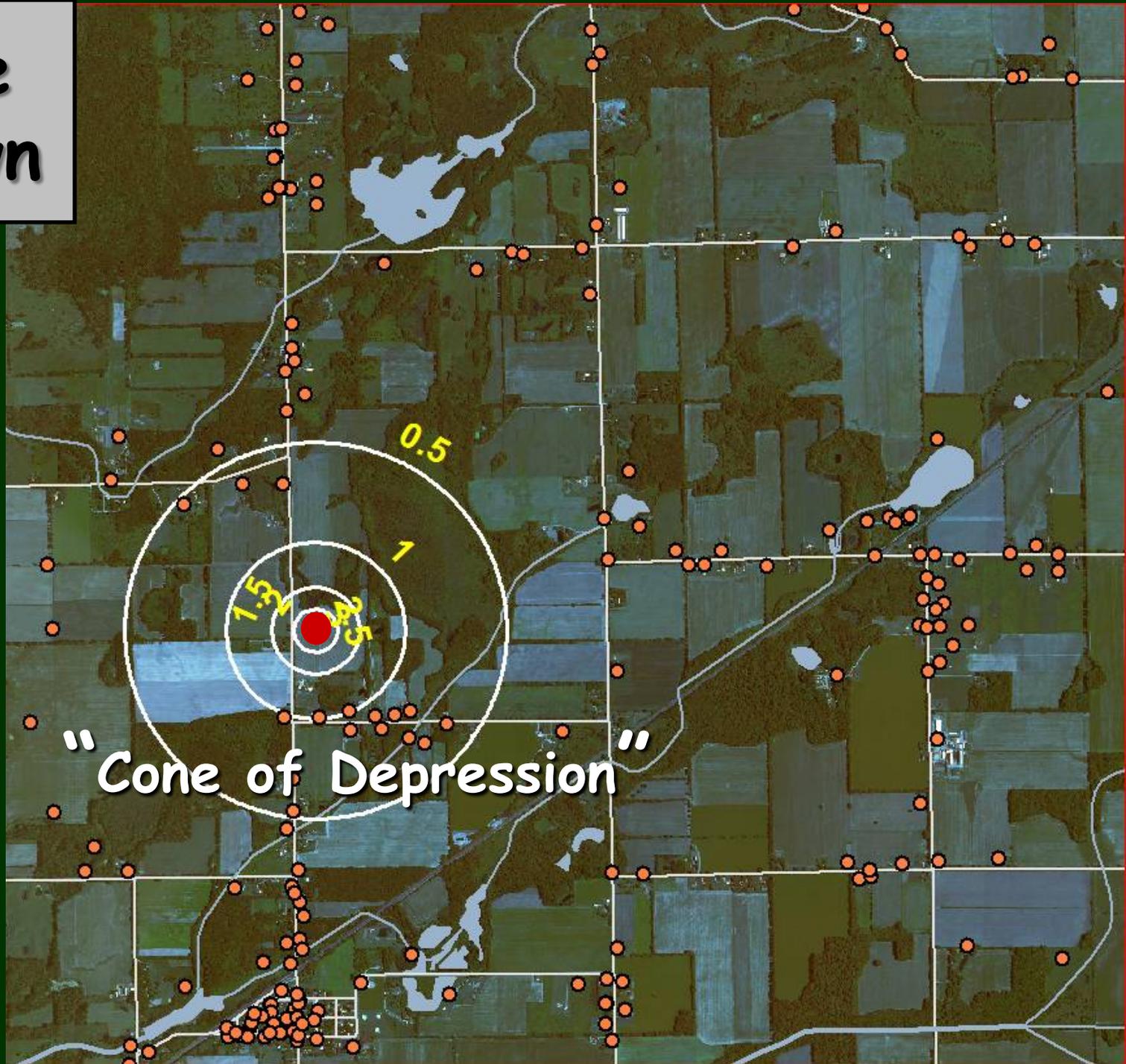
**Forward
Particle
Tracking**



Calculate Drawdown

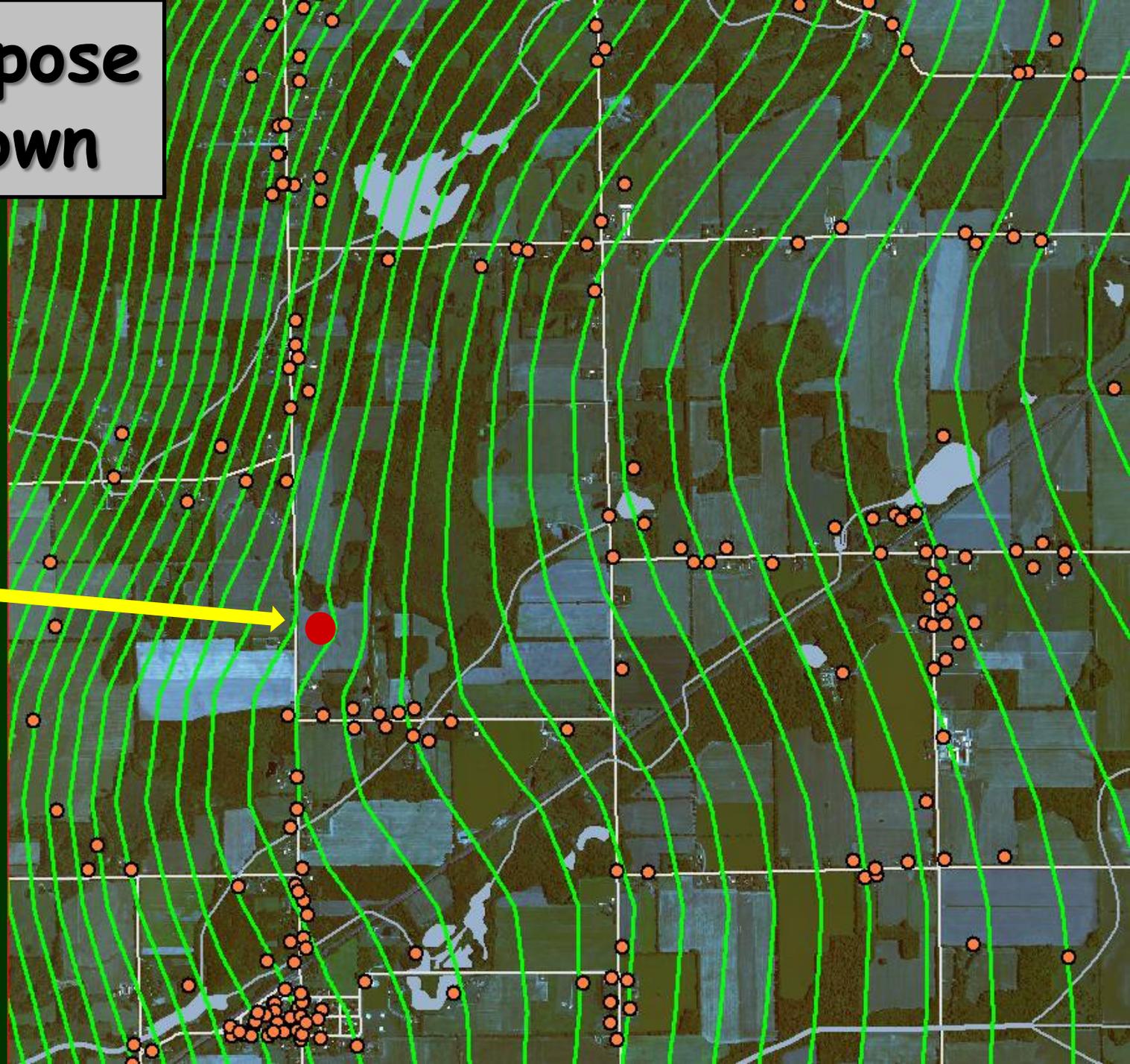
Simulate
Impact of
Well

100 Days
continuous
pumping



Superimpose Drawdown

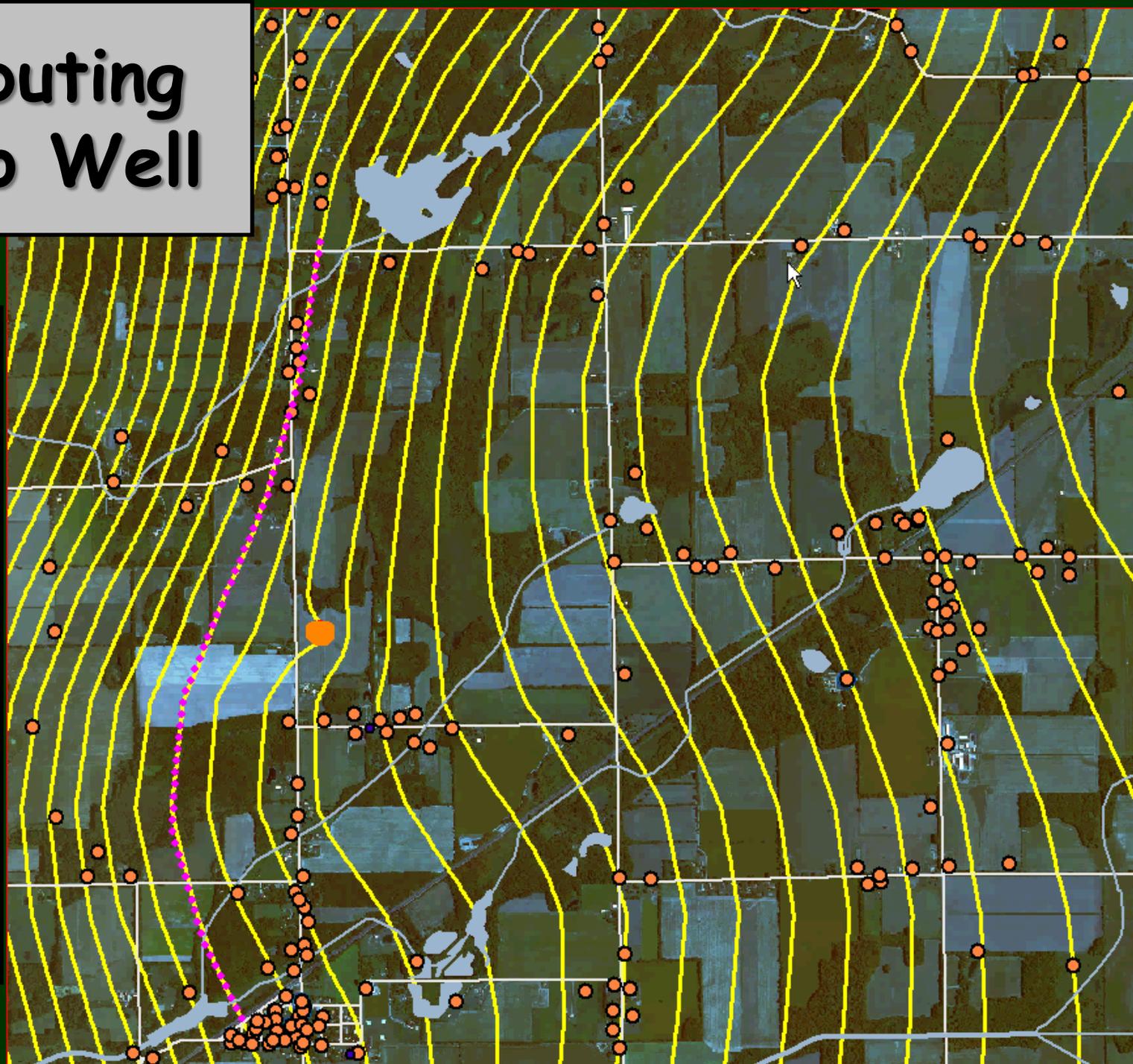
Note deflection in potentiometric surface



**Contributing
Area to Well**

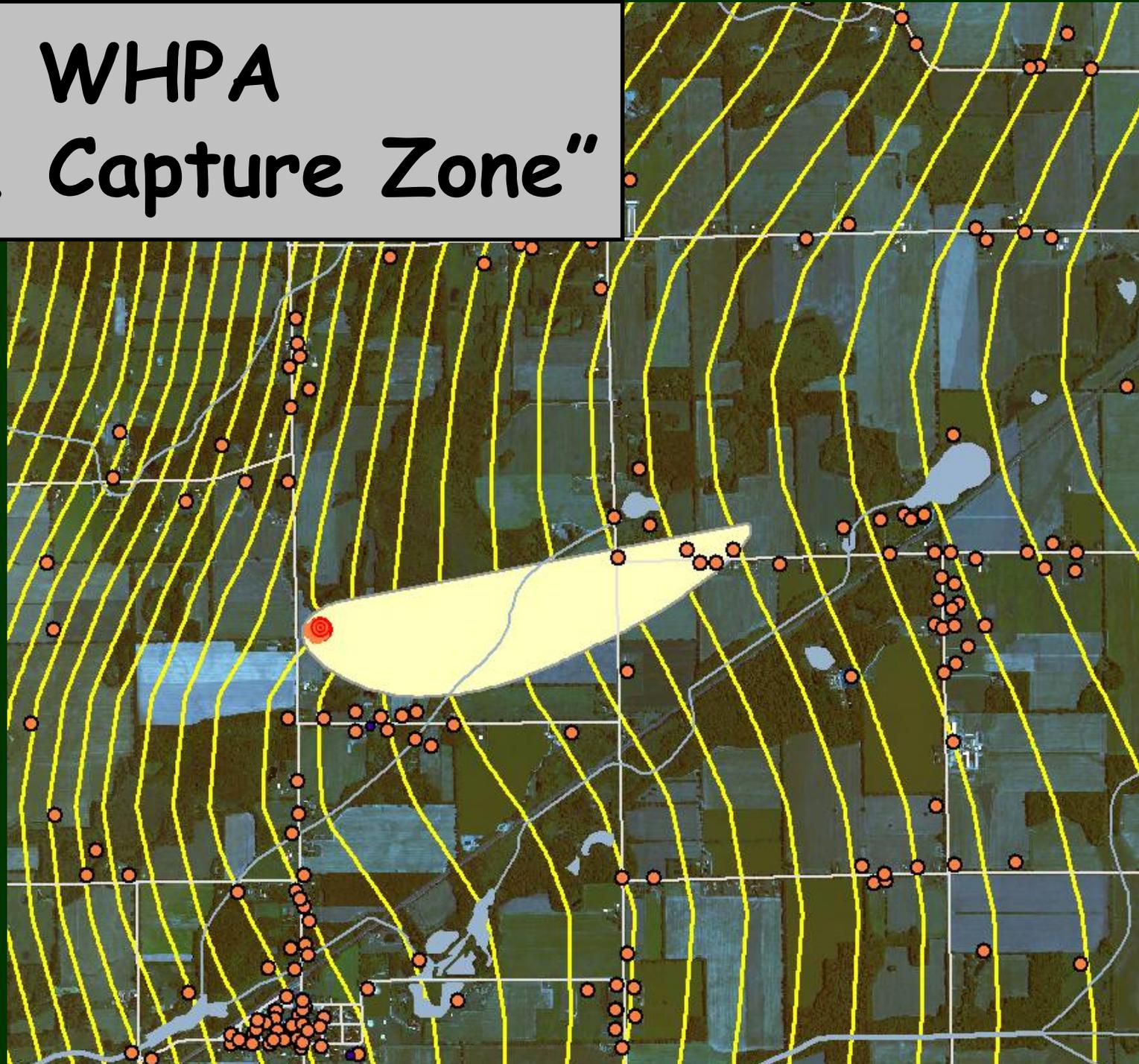
**GW
Flow
with
Pumping**

**Reverse
Particle
Tracking**



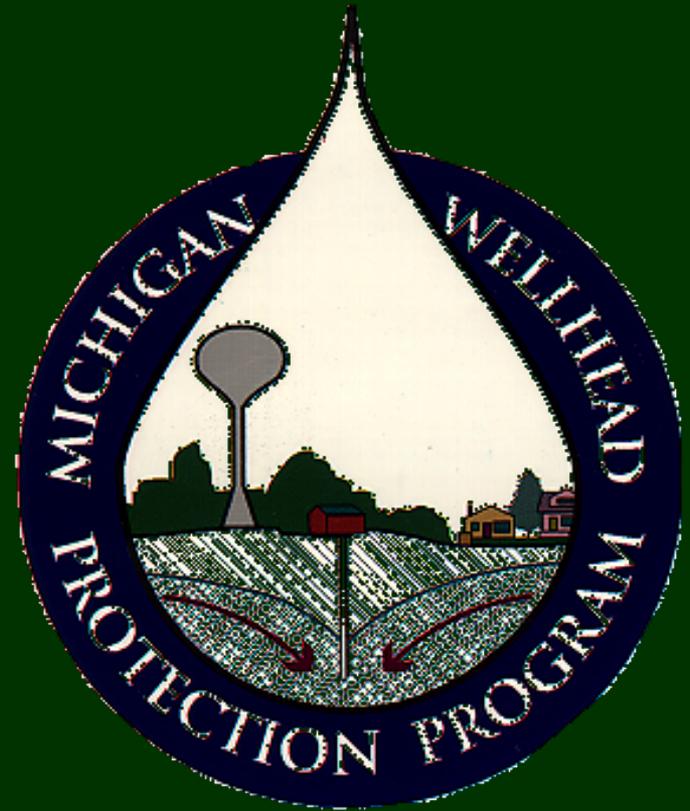
WHPA

"10 Yr. Capture Zone"



MGMT

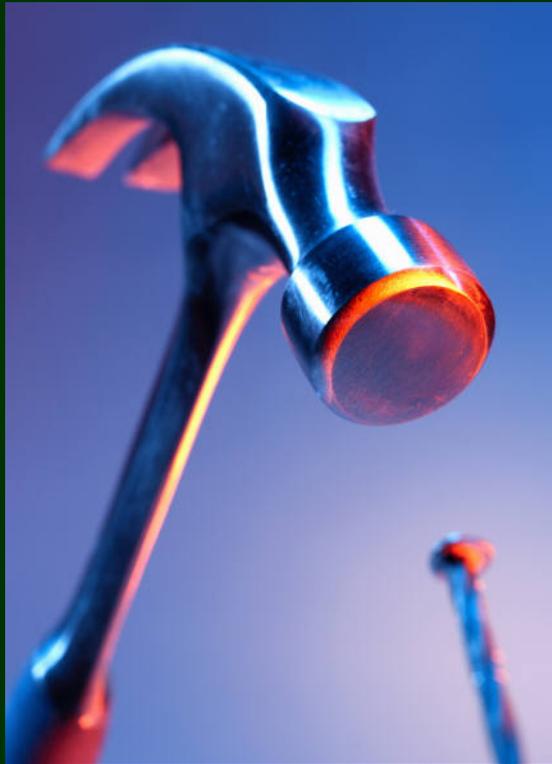
Michigan
Groundwater
Management
Tool



MGMT

A tool for analyzing groundwater flow using available data

- Delineating WHPAs
- Contaminant migration
- Groundwater flow direction



Why Not Use
Existing
Information?

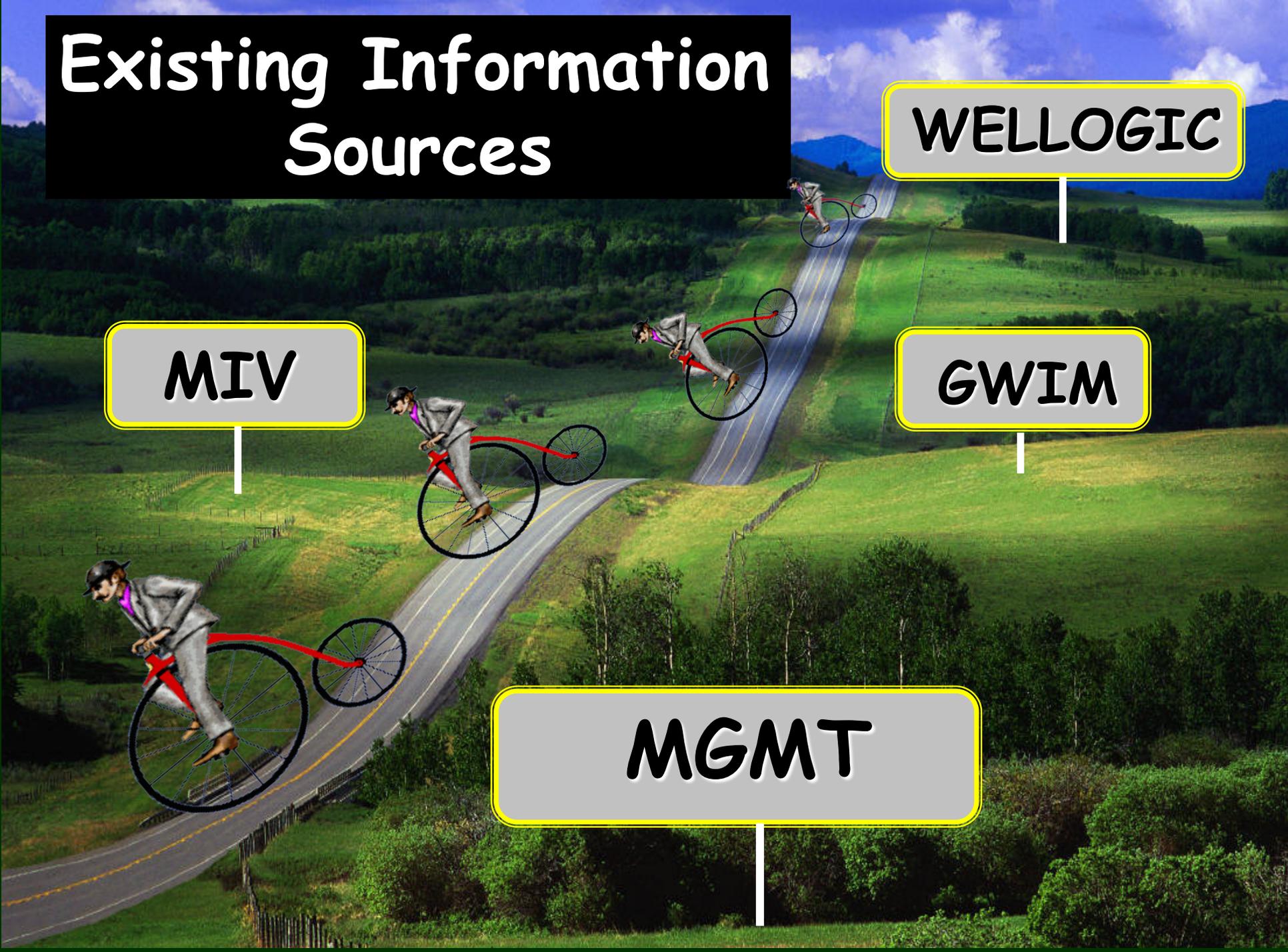
Existing Information Sources

WELLOGIC

MIV

GWIM

MGMT



NECESSARY INFORMATION (Revisited)

- GW Elevation Map
- Hydraulic Conductivity
- Well Location
- Pumping Rate

Available Data

WELLOGIC

- Water Well Database
- ~575,000 Records
- Well Locations
 - Lat/Long
- GW Elevations
 - Land Surface
 - Static Water Level
- K Estimates
 - Assigned during the GWIM Project
 - Lithology and Land System based



Information from Water Well and Pump Record

Location

870 Location SL

20 ft
Surface

Static Water = 850 ft
Elevation

SE Elevation
Level

GWMA Project

Geology
K

Assignment

Water Well And Pump Record				Welllogic	
Completion is required under authority of Part 127 Act 365 PA 1978. Failure to comply is a misdemeanor.					
Import ID: 4100120022		County: Kent		Township: Soke	
Tax No:		Permit No:		Source ID/Well No:	
Well ID: 41000007355		Town/Range: 10N 11W		Section: 23	
Elevation: 870 ft		Well Status: Inactive		WGSN: 2069341	
Latitude: 42.237685218		Distance and Direction from Road Intersection: SUNSHINE FIELDS DAY CARE			
Longitude: -85.5715685288		Well Owner: TIEDLER, HAROLD			
Method of Collection: Interpolation-Map		Well Address: 14951 WHITE OAK AVE CEDAR SPRINGS, MI 49319		Owner Address: 14951 WHITE OAK AVE CEDAR SPRINGS, MI 49319	
Drilling Method: Cable Tool		Well Depth: 4500 ft		Well Use: Type II public	
Well Type: Replacement		Well Date Completed: 6/12/1985		Pump Installed: Yes	
Casing Type: Steel - black		Casing Weight:		Pump Installation Date:	
Casing Joint: Threaded & coupled		Casing Fitting: Drive shoe		Manufacturer: Other	
Diameter: 4.00 in. to 40.00 ft. depth		Borehole:		Model Number:	
Static Water Level: 20.00 ft. Below Grade		Pumping level 20.00 ft. after 1.00 hrs. at 40 GPM		Drop Pipe Length: 30.00 ft.	
Screen Installed: Yes		Filter Packed: No		Drop Pipe Diameter:	
Screen Diameter: 3.75 in.		Blank: 0.00 ft. Above		Drop Down Seal Used: No	
Screen Material Type:		Fittings: Neoprene packer		Pressure Tank Installed: No	
Slot: 10.00		Length: 5.00 ft.		Pressure Relief Valve Installed: No	
Well Grouted: No		Well Head Completion: Filter adapter		Formation Description	
Nearest Source of Possible Contamination:		Type: Septic tank		Thickness	
Distance: 100 ft.		Direction: South		Depth to Bottom	
Abandoned Well Plugged: No		Reason Not Plugged:		Sand	
Reason Not Plugged:		Drilling Machine Operator Name:		Gravel & Clay	
Other Remarks: Pump Manufacturer: EDCATUR PUMP CO		Employment: Unknown		Red Clay	
EGP-2017 (42010)		Contractor Type: Unknown		Sand & Gravel	
Page 1 of 1		Reg No: 0074			
LHD 2/17/2000 9:24 PM		Business Name:			
		Business Address:			
		Water Well Contractor's Certification			
		This well was drilled under my supervision and this report is true to the best of my knowledge and belief.			
		Signature of Registered Contractor		Date	

Estimate Hydraulic Conductivity

"K"

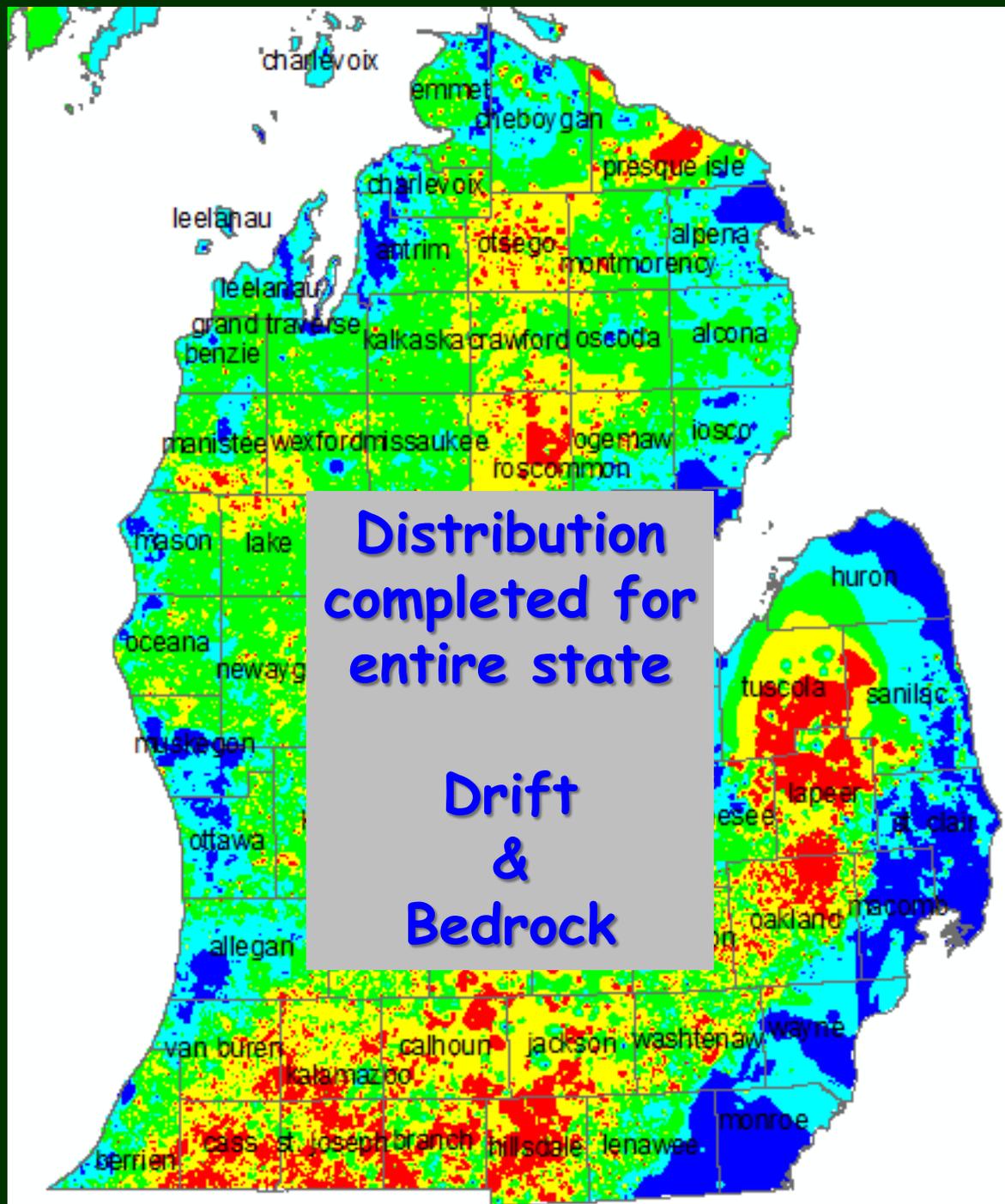
High

Medium/High

Medium

Low/Medium

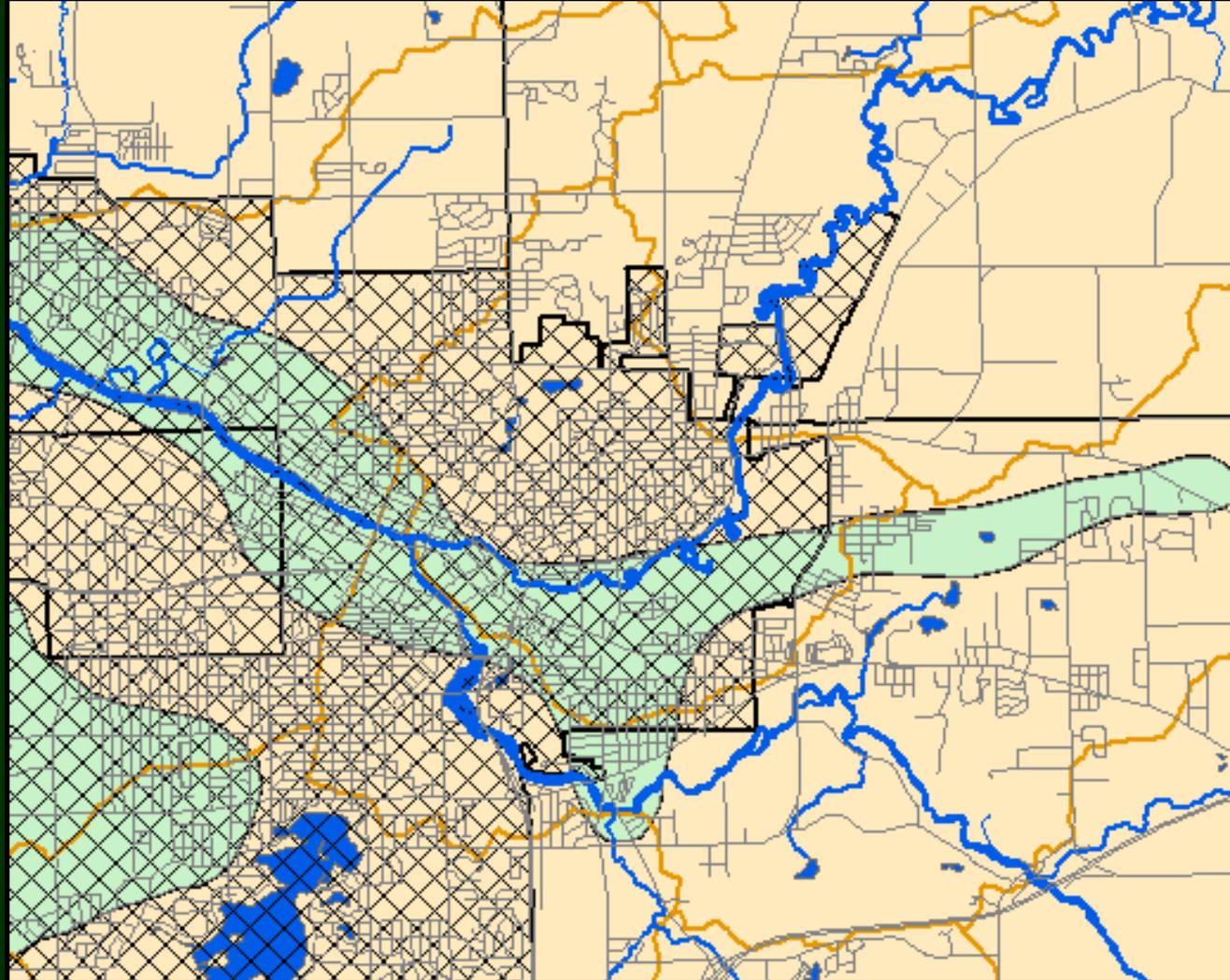
Low



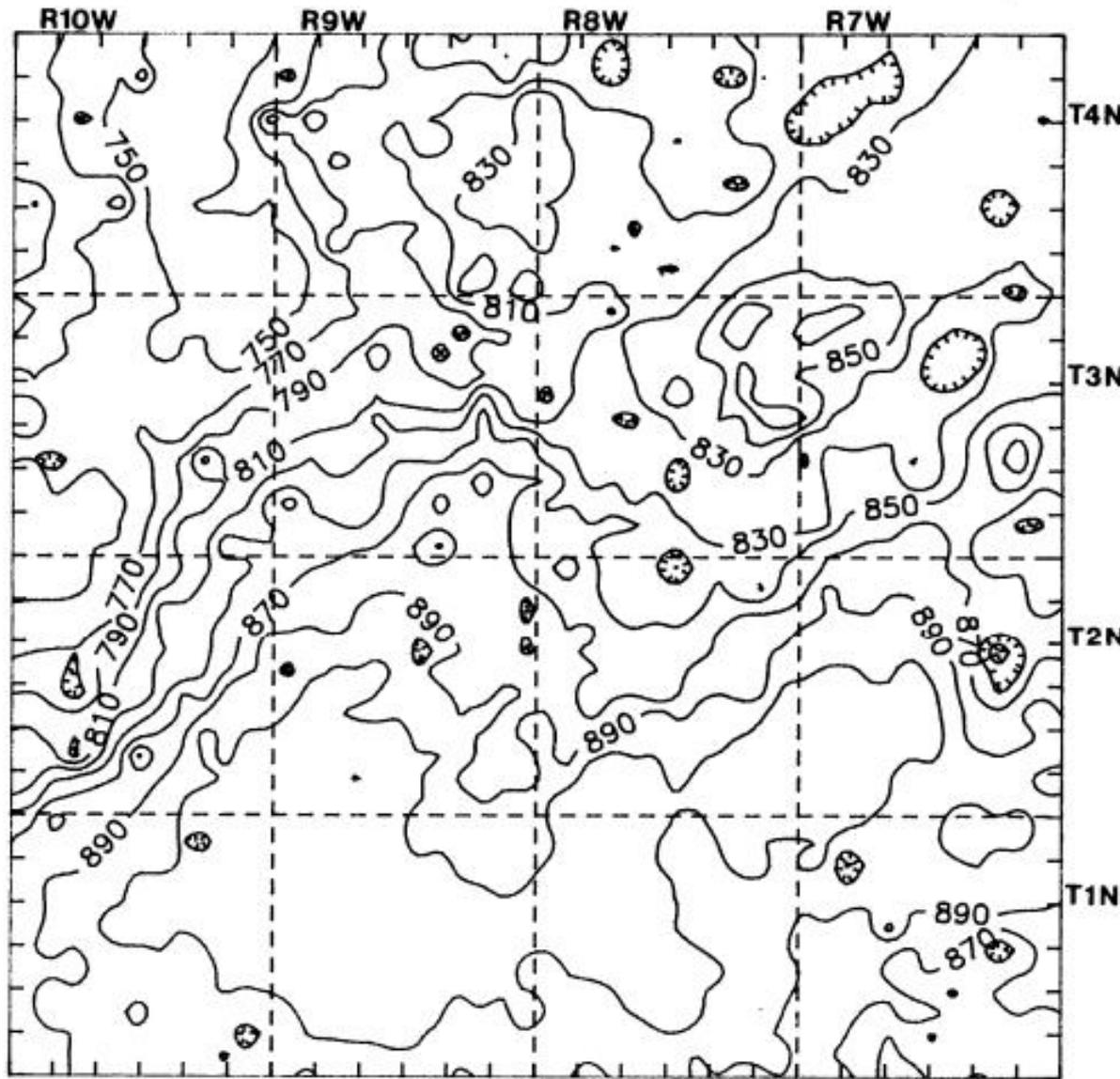
Michigan Geographic Data Library

- Political boundaries
- Roads
- Lakes
- Rivers
- Watershed boundaries
- Air photos
- Geologic maps
- etc.

Other Available Data



How Do We Map GW
Elevations and Determine
GW Flow Directions From
Available Data?



SCALE 1:16000
0 16000 48000 FT.

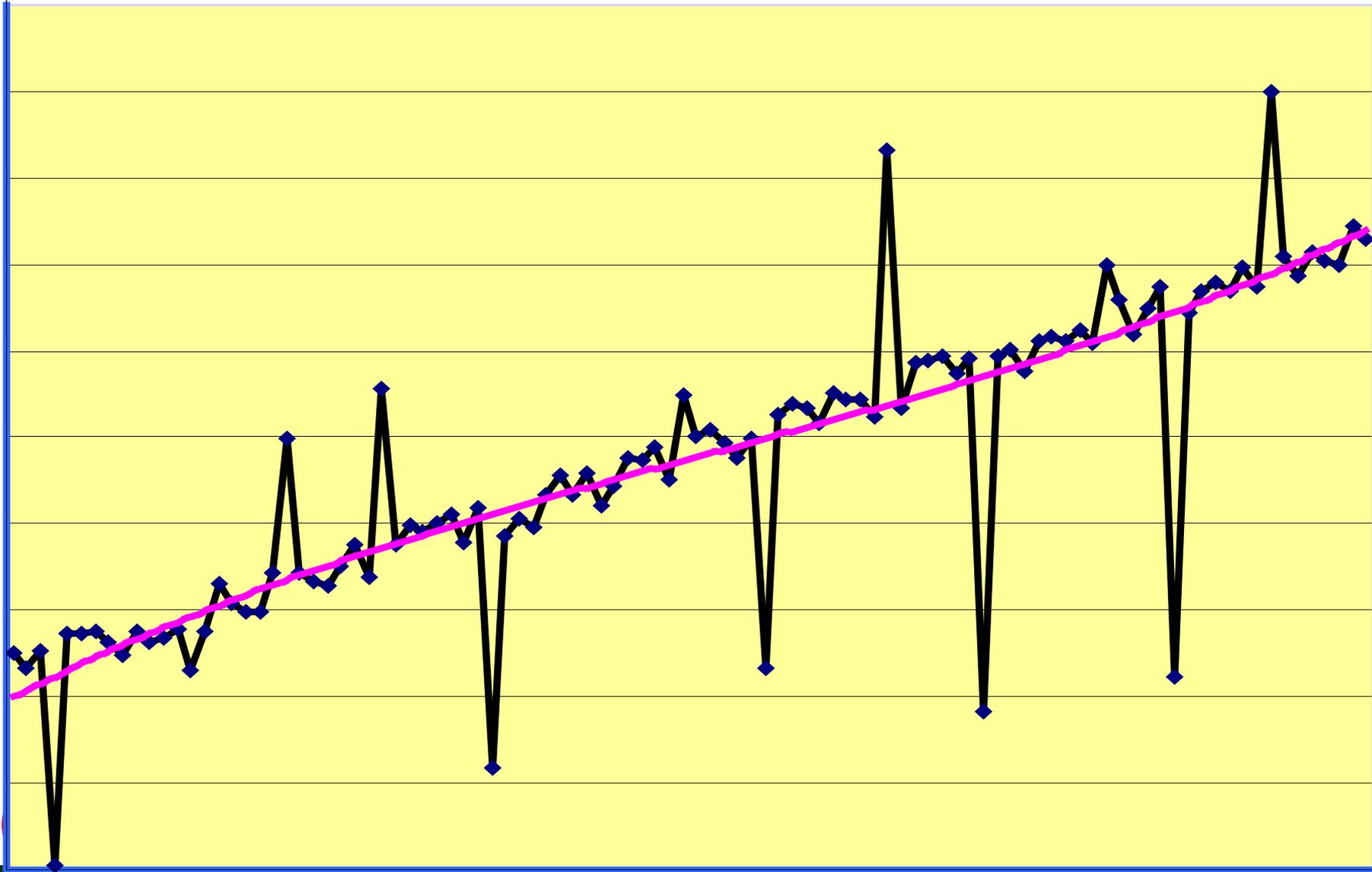
Potentiometric
Surface from
WELLOGIC
Data

Basic
Kriging

Data Processing

- Using water well records only
- Remove noise and data errors
 - Filtering
 - Outlier analysis
- Kriging
 - Data interpolation
 - Smooth surface depicting GW flow

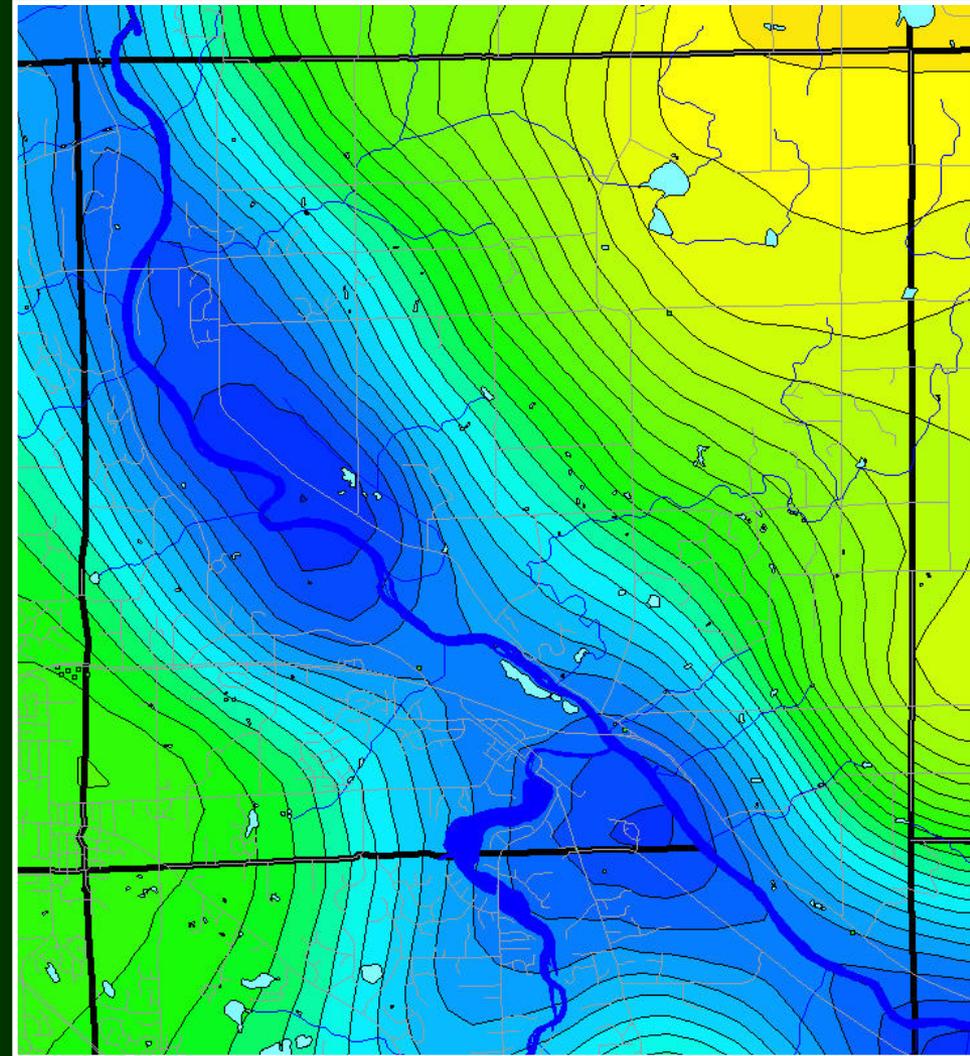
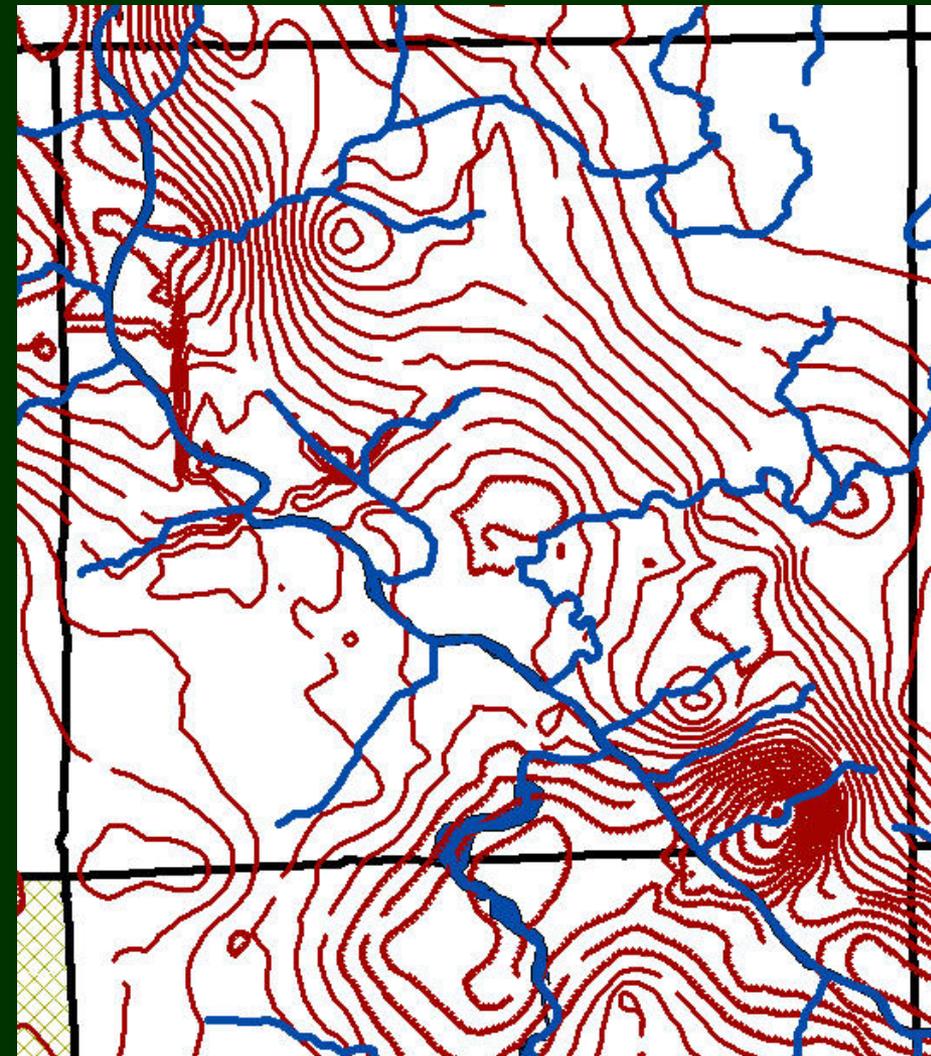
Filtering and Outlier Analysis



Potentiometric Surface Comparison

Standard Kriging

MGMT Kriging



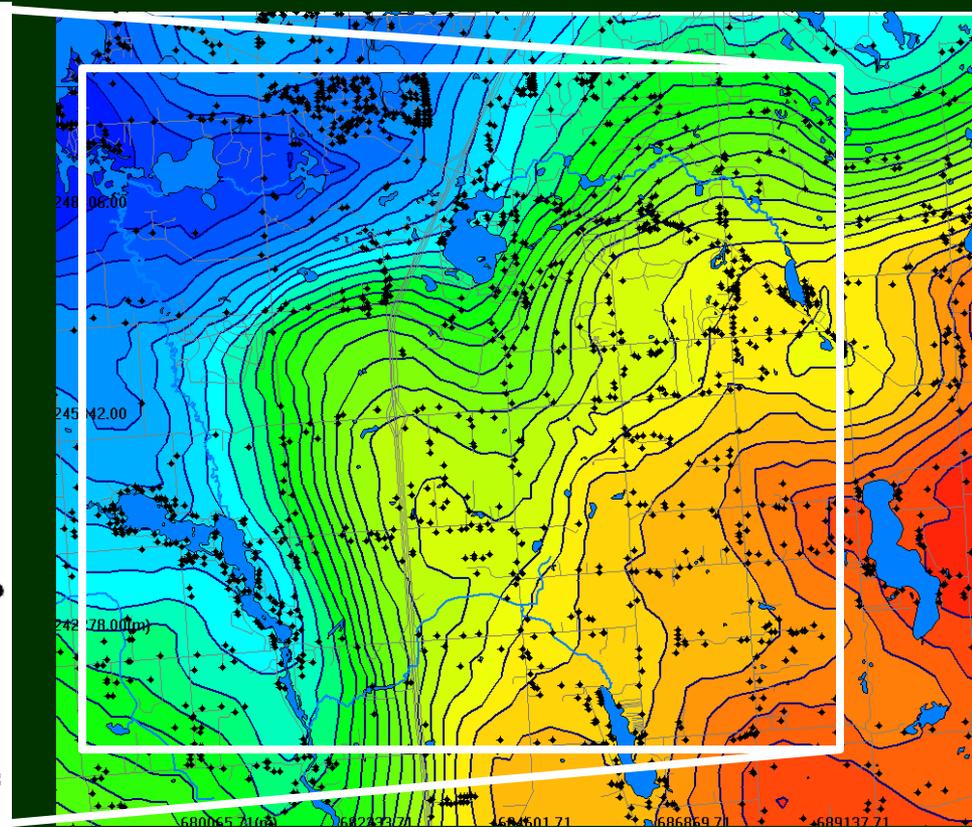
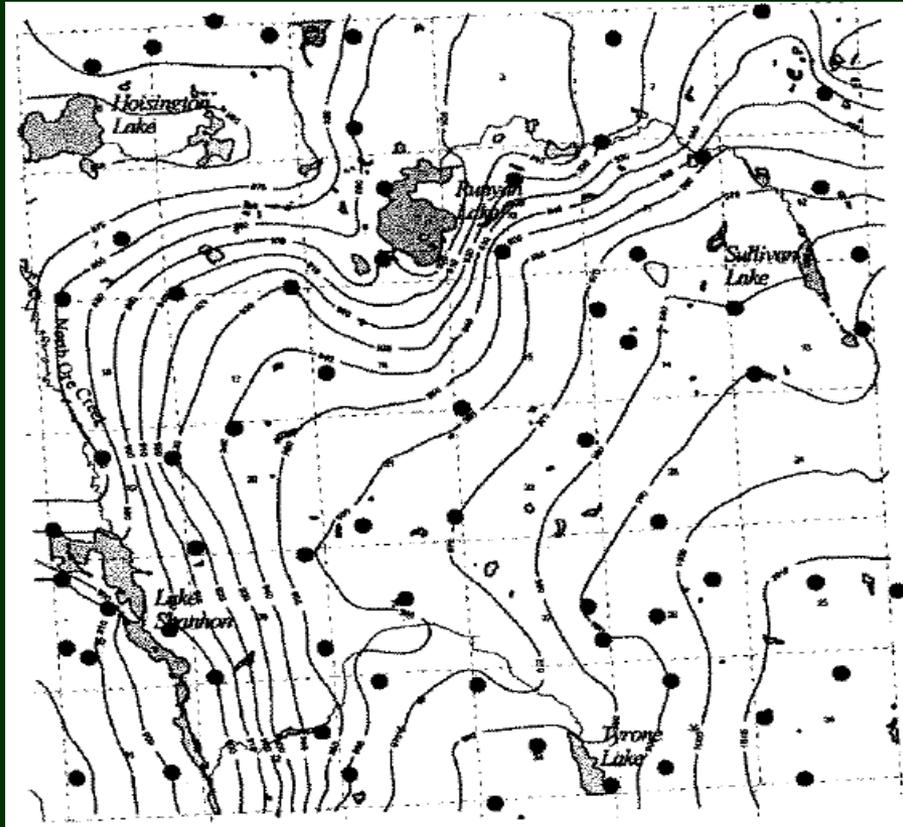
What Did We Do to Show
That Our Data Processing
Resulted in Correct GW
Flow Directions?

Comparison Between
Field-Generated Maps
And
MGMT-Generated Maps

FIELD versus MGMT

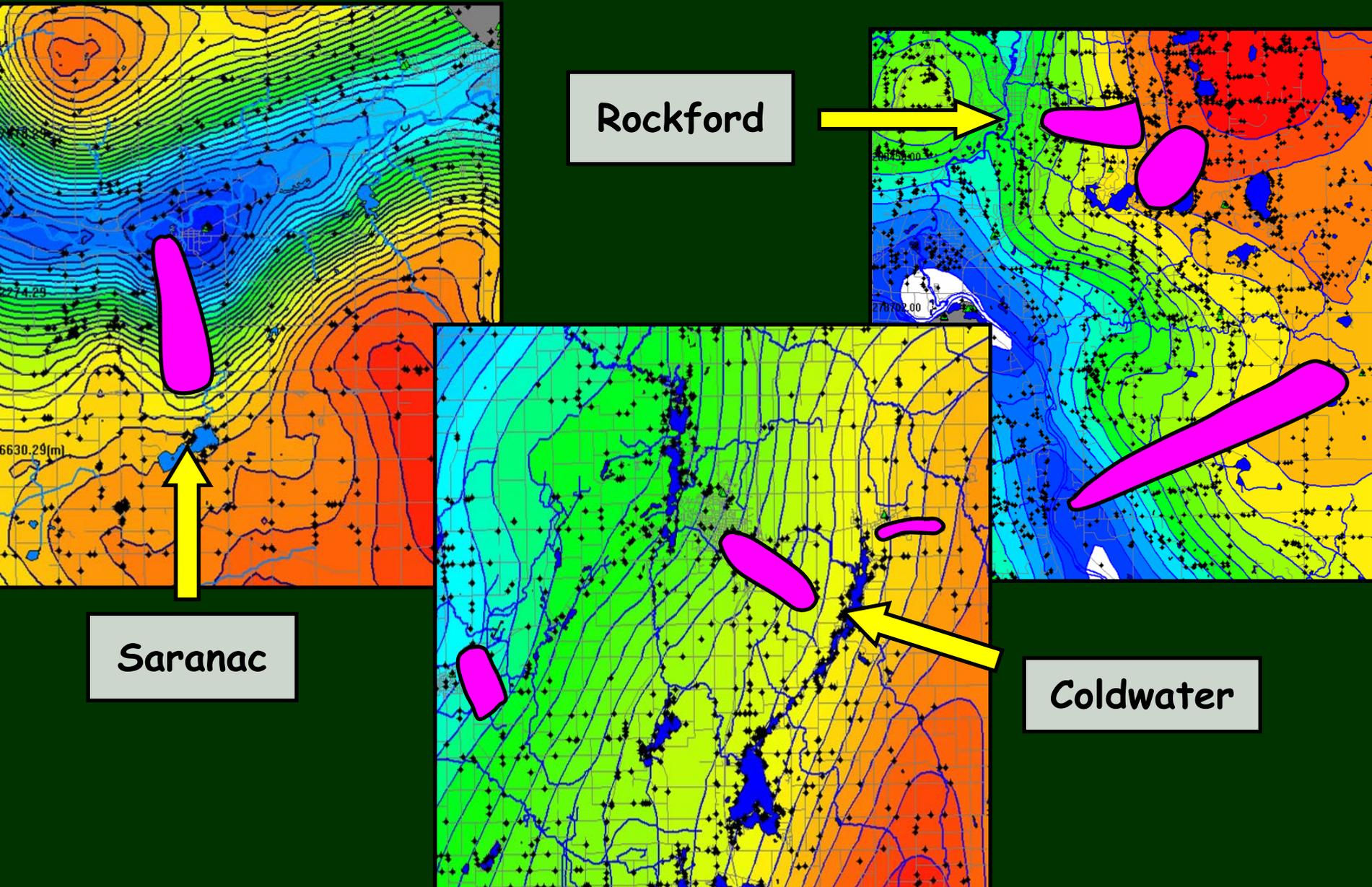
Measured - 66
points

MGMT - 1737
points



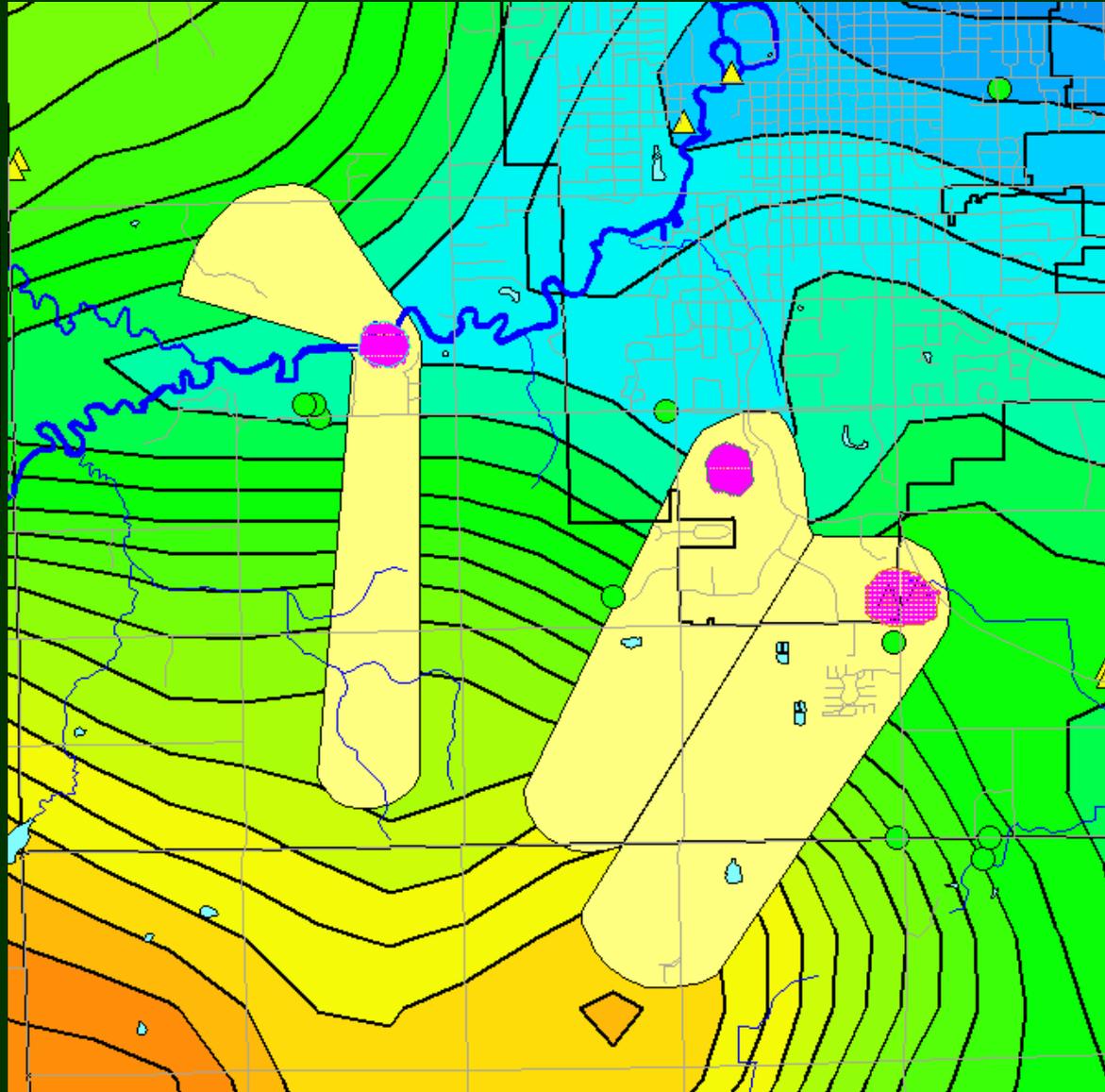
Comparison between Orientation of Traditional WHPAs and MGMT Maps

GW flow direction Verification



Compare traditional WHPA delineation with MGMT delineation

City of
Mount
Pleasant



Proposed Uses of MGMT

- Delineation of “Provisional” WHPAs:
 - Community water supplies without the resources to complete WHPA delineations
 - Nontransient, Noncommunity water supplies
 - Completed district by district
- Evaluation of new well sites
 - Community
 - Non-Community systems

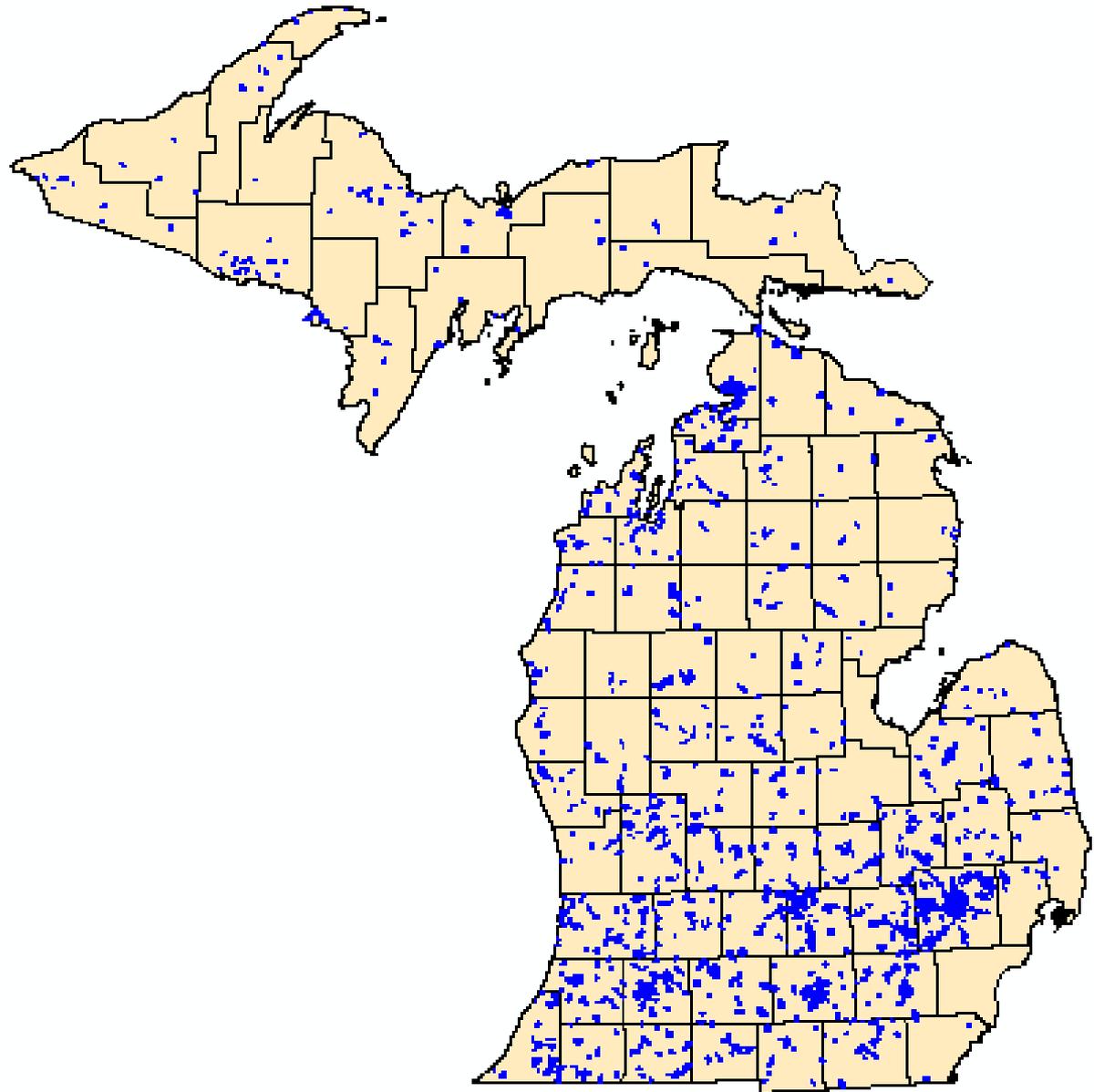
Note on Provisional WHPAs

- Traditional WHPAs are differentiated from Provisional WHPAs
- Wellhead Protection activities in both are eligible for grant funds
- They do not eliminate the need or value of traditional WHPA delineations

Community Water Supply Database

- 3,450 Wells
Lat-Long
Locations
Confirmed
- WHPAs
Traditional – 324
Provisional – 897
Low Tritium – 55
Total - 1276

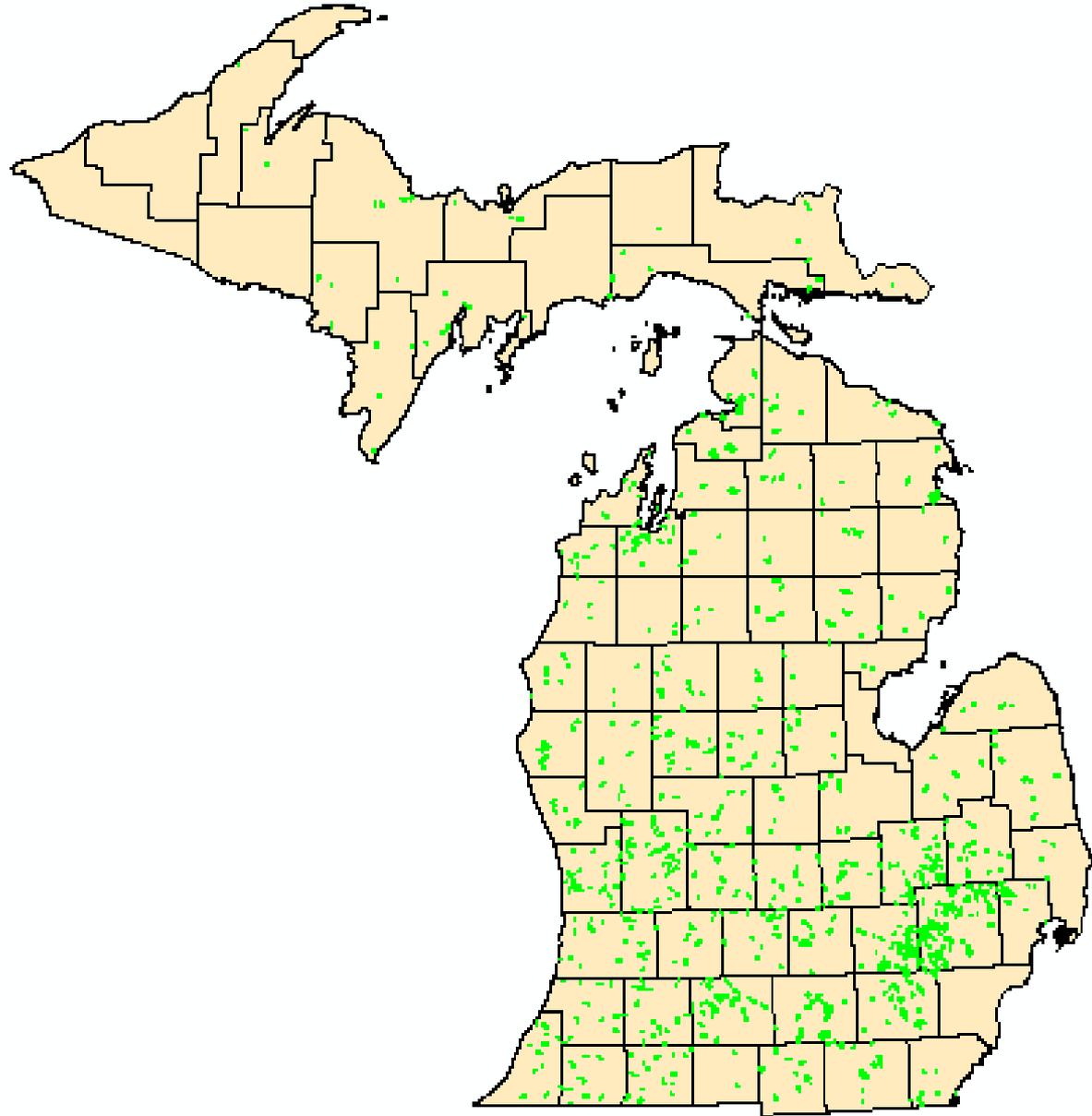
Available Data



Available Data

Nontransient Noncommunity Water Supplies

- 1,931 Wells
Locations
Confirmed
- Provisional
WHPAs
1434



Post-MGMT WHPA STATISTICS

Area of Michigan

1270 WHPAs - 3161001.22 mi²

Low Vulnerability

Type II NTR WHPAs
53 SWPAs - 158.14 mi²

1394 WWPAs - 814.46 mi²

Traditional

329 WHPAs - 646.69 mi²

Total

2664 WHPAs - 2415.68 mi²

Total

382 SWPAs or WHPAs

WHPAs as Percentage
80483 mi²

2.498 %

Pre-MGMT: 0.832%

